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ON-LINE CIRCULATION CONTROL— MIDWESTERN UNIVERSITY LIBRARY'S SYSTEM USING AN IBM 1401 COMPUTER IN A "TIME-SHARING" MODE

In November 1967, an on-line automated circulation control system was put into operation in the Moffett Library at Midwestern University. The system is designed to charge, discharge, and list all materials in circulation, as well as to detect overdue materials, prepare notices and compute fines. The uniqueness of the system lies principally in the configuration of the equipment and the programming to provide for on-line operation. (See Figures 1 and 2). Through a program interrupt capability, an IBM 1030 Data Collection System (IBM 1031 input station, and IBM 1033 printer) is linked with a second generation computer (1401-16K) in an on-line mode that allows other departments on campus to use the computer when it is not in actual use by the Library (See Appendix A).

Although other libraries have developed on-line circulation systems, few, if any, have done so without employing either a third generation computer or a computer to be used solely by the library. That a system can be designed to provide an on-line capacity for nearly simultaneous data processing for more than one department using a second generation computer is additionally noteworthy in view of the already widespread availability of the IBM 1400 series

Figure 1

SYSTEM CONFIGURATION

1401 (16K)	Data Processing System
1402	Card Read Punch
1406	Storage
1311-004	Disk Storage Drive
1311-002	Disk Storage Drive (2)
1403	Printer
1409	Console Auxiliary
1026	Transmission Control Unit
1031	Input Station
1033	Printer

The 1401 has the following features:

Advanced programming

Disk storage drive adapter

Expanded print edit

High-low-equal compare

Print control

Punch feed read control

Space suppression

Sense switches

Approximately 4500 positions of core are reserved for library use, and one disk drive is allocated to the library for circulation control.

Figure 2

CORE MAP

1. Library Monitor	150
2. Disk IOCS routines	437
3. Dump routine	332
4. Library processing routines	3576
Total Library	4495
5. Background programs (all IO handled by monitor)	11505
Total Capacity	16000

computer. Experience with the Midwestern University installation indicates that it is not only possible for a relatively inexpensive computer such as the IBM 1401 to handle library circulation transactions on-line in "real-time" but that it can also perform other administrative and record-keeping work virtually simultaneously.

Multi-programming techniques, which are normally considered too sophisticated for computing hardware of this generation, permit the Midwestern University Library, which could not afford a computer of its own, to use this computer just as if it were wholly dedicated to the Library, and without severely affecting the machine's productivity in handling other work. The system design assures the currency of library records, facilitates services, and makes possible circulation control activities which are not economically feasible with manual or off-line automated systems.

The system accurately identifies the patron and charged-out materials, provides for variable loan periods, simplifies circulation procedures, provides data on loaned material, detects overdue books and prepares appropriate overdue notices, provides a system of holds, obtains a daily count of charged-out materials, provides classification data on books used, and provides management reports. This new Midwestern installation is able to do all of these things, plus others, more efficiently and more simply.

This application of the 1030 Data Collection System, coupled in an on-line capacity with the 1401 computer in a remote facility, offers these additional, particularly desirable features:

1. The loan period is coded into each bookcard; this eliminates the need for the multiple date-due cartridges employed in the IBM 357 system.

2. The on-line capacity provides the ability to override the loan period in the bookcard by coding the borrower's badge either to lengthen (for faculty), or to shorten (for area users) the loan period.

3. The on-line capacity in this system provides the ability to automatically withhold materials from a delinquent borrower until overdue materials are returned, fines paid, or an override command given.

4. Reserve books are automatically returned to reserve status when they are discharged. They then appear on the daily circulation print-out as charged to reserve. (Though the library does not presently have any books on hourly reserve, this status would be accessible by a slight modification of the system, and by the addition of a clock mechanism).

5. When necessary or convenient the library can determine who has what items checked out and whether they are overdue by means of an on-line inquiry feature.

6. In capturing more data in each bookcard than off-line systems will permit, this system produces more intelligible records without accessing a master record file (see Figure 3).

In addition to these features, the experience of Moffett Library in the application of on-line automation techniques to library circulation control underscores five additional aspects:

1. If a non-dedicated second generation computer can serve the library in an on-line capacity, the same machine can serve other departments on campus as well. (The implications of this statement certainly might prolong the useful life of the second generation computer far beyond present proposed utilization.)

2. A highly desirable level of sophisticated computing operations (on-line status) is possible with a second generation computer.

3. On-line systems are no more difficult to implement than off-line systems, and in fact, in some respects, on-line systems require simpler programs.

4. In converting present manual operations to automated procedures, it is not necessary and, indeed, it may even be undesirable, to convert to off-line status in preparation for full conversion to an on-line operation. (Some installations will find that it would have been better not to convert to a semi-automated system, but rather to wait until it would have been possible to convert to a full on-line operation.)

5. Efficient manual and automated off-line systems cannot duplicate advantages inherent in an on-line system, either in circulation control, or in other areas within the library.

Limited funding, an all-too-common problem for most libraries, has often made it impractical to automate circulation and associated procedures. Moffett Library, experiencing increasing levels of circulation, faced this problem in 1967. At that time, a study of automated circulation control systems was begun, and it was concluded that an on-line system permitting continual instantaneous communication between the Library's circulation desk and a computer would be most desirable.

Figure 3

PAPER DOCUMENT SAMPLES
(FINE NOTICE AND DAILY CIRCLUATION LISTING)

MOFFETT LIBRARY MIDWESTERN UNIVERSITY DATE 04/07/69
3400 TAFT BLVD. WICHITA FALLS, TEXAS 76308

NOTICE OF FINE PAYMENT NOW DUE

CALL NUMBER AUTHOR/TITLE				DUE DATE FINE DUE
PS3511. .A86 M35 1959				/ / $1.00
FAULKNER W MANSION				

455 74 1730

TIDWELL PATRICIA GARNER
500 FILLMORE APT 2
WICHITA FALLS TEXAS

FINE RATE IS 25 CENTS PER DAY PER BOOK.
HOLDS MAY BE PLACED ON DELINQUENT ACCOUNTS.

This conclusion, however, posed a particular problem, since the only computer available in the University was a second generation IBM 1401-16K, which had been given to the University by two benefactors. The computer was being used to process administrative work for the University, and it was thought incapable of handling library work on-line in "real-time" while doing other work required, as do the larger, and consequently more expensive "time-sharing" or "multiprogrammed" third generation computers.

Ideally, the library might have wished to purchase its own computer, which would then have been a machine dedicated to Library operations; however, the shortage of Library funds proved to be a deterrent to this solution.

The Library thus had a choice of abandoning its hopes for an on-line circulation control system, or developing programming for its existing 1401 so that it would be on continuous call to the Library, while at the same time handling administrative and other routines. Though no one else was known to have accomplished this with a 1401, the decision was made to develop such a dual usage system. Those who examined the situation concurred that it was at least theoretically possible to accomplish this.

Once the decision was made to install the circulation control system, less than eight weeks were required to implement the system design. As previously indicated, the system consists of a remote 1030 data collection system in the library, which is linked to a 1026 transmission control unit that operates under the control of the 1401 in a remote location in the University's data processing center. The system essentially revolves around a computer-maintained "master magnetic disk" record of circulation transactions, including current data on location of volumes, fines owed, and past due or other irregular situations. One of three 1311 magnetic disk drives available in the computer center is dedicated to the library circulation control system.

Briefly, as the system does administrative work for the University in the data processing center, it is on continuous "call" to the Library during the eighty-five hours of the Library's operation each week.

Whenever a library assistant wishes to transmit a transaction–for example, a book to be charged out–he simply transmits the required data, as recorded in a machine-readable bookcard and a student ID badge encoded with the borrower's identification number, to the data processing center, via the 1031 input terminal which reads from the card and badge and transmits the data via an underground cable to the 1026 transmission control.

At the data processing center, the computer is constantly monitoring the transmission control unit to determine whether data are being transmitted from the Library. If data are being transmitted, the computer momentarily stops whatever job it is doing and processes the library transaction, thus updating effective library records on the magnetic disk drive. The 1401 then sends back, via the 1026 transmission control, the particular message required to the output station (the 1033 printer) at the Library. Having completed this transaction, the computer picks up where it had left off when the transmission from the Library was received.

At the library data collection unit, the average "turn-around" time for a complete transaction is seven seconds. However, the computer is interrupted

for only about a second–a time so short that it appears to the observer that there has been no interruption at all.

Programming for the system proved to be actually simpler than the programming required for most off-line operations. The program, written in an IBM Autocoder language, is essentially a "monitor" which remains loaded in core and which is constantly polling the transmission control unit for incoming data from the Library. Upon recognition of an input signal, the computer executes, under the supervision of the monitor, an instruction to halt momentarily the job in process, and switches to the portion of the library program required to handle the particular type of library transaction being received. Once the transaction is completed, the monitor turns the control back to the original program which was interrupted by the initial receipt of a library transmission. IBM's standard DIOS (Disk Input-Output System) programming is used to access the disk file.

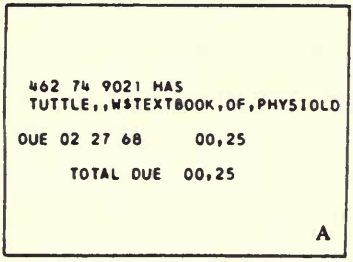
When a borrower wishes to charge materials and the information is sent via the 1031 input station to the computer, the computer first checks to determine if there is a hold on the title and then ascertains the status of the borrower. If the borrower currently has past due materials or owes an unpaid fine, the 1401 transmits a message to this effect (see Figure 4), and will not charge out another book until the delinquent account has been cleared, or the machine is instructed to make the charge by an override command.

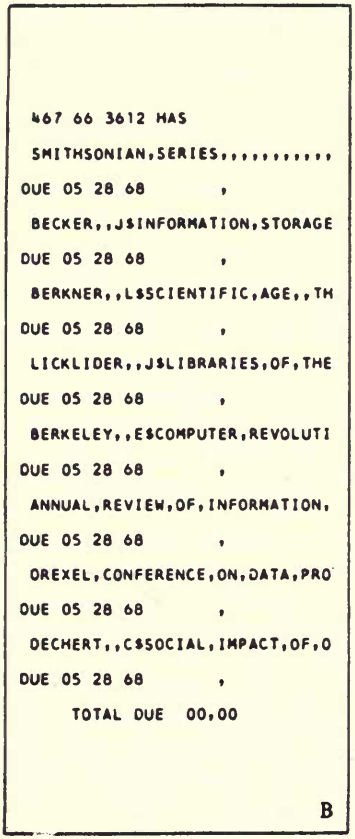
In this system, the loan period is coded into each bookcard. The on-line capacity, however, provides the ability to override the loan period specified in the book, in accord with a specific override command encoded in the borrower's badge, either to lengthen the loan period (for faculty) or to shorten it (for area users not enrolled in the University). In fact, encoding the borrower's badge can prohibit certain borrowers from obtaining materials from the Library through the system, unless an override command is given–for example, reserve material will not, under normal circumstances, circulate to area users. It will be noted that no intervention of the library assistant is needed to lengthen or shorten loan periods, nor to check the status of the borrower, as each process is an automatic one with each transaction by pre-programmed instructions to the computer.

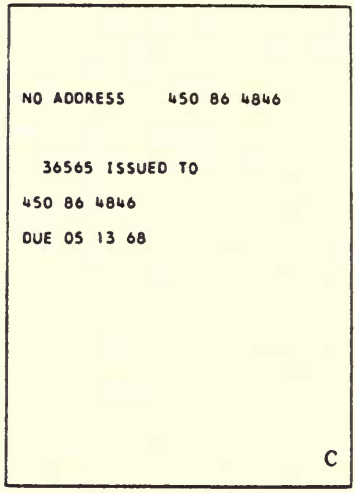
If the status of the borrower is clear, once the length of the loan period has been determined by the machine, a notice is prepared by the 1033 typewriter which is, in effect, a date-due slip. The slip contains the accession number for verification at the door checkpoint, the borrower's number, and the date due. This slip, together with the bookcard, is returned to the book pocket.

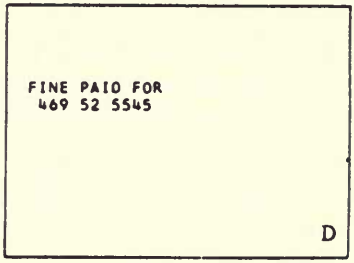
Discharging procedures are nearly identical, except that the borrower need not be present. The information to discharge a book is fed via the data collection system to the computer, and the record is erased from the borrower's responsibility unless a delinquent condition is noted. If the returned book is overdue, this fact will be noted by the computer, the fine calculated, and the charge erased from the student's responsibility, though the fine will remain until it is separately erased.

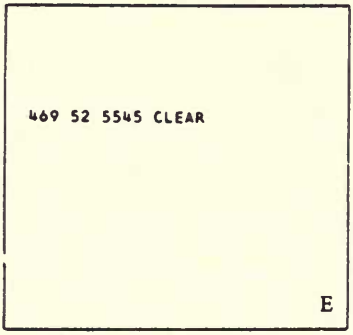
The on-line status of the circulation control system also permits immediate inquiry to determine what a particular borrower may have charged











Examples of inquiry responses

A. Automatic inquiry performed when book is attempted to be checked out.
B. Typical patron inquiry.
C. No address notice. (At this point, assistant hos patron fill out address card.)
D. Fine-paid-for notice.
E. Inquiry notice—nothing out or overdue.

Figure 4 — Transaction Slips from Output Terminal

to him, whether the material is overdue or not, i.e., the system can report all items charged to a borrower at any given time (see Figure 4).

Also, the on-line status permits a specific title to be charged and discharged any number of times each day, and only the latest record of possession of the piece will be retained by the computer, with earlier charges being destroyed as the latest charge is recorded. This is particularly beneficial, for a number of off-line automated circulation systems have found it to be difficult to keep track of a piece which is charged and discharged several times during a day, before the record is updated.

Certain daily reports are generated by batch mode processing, at the end of each day's activity, a listing showing all transactions (basically an audit statement) is produced. In addition to the audit statement, a complete circulation listing indicating all volumes in circulation is produced, with volumes arranged in call number sequence. In addition to the call number, the accession number, short author-title statement (43 characters– variable-length author statement), the borrower's identification number, and the date due are included. A third listing arranged by borrower is also produced, indicating all books overdue and all fines owed by each borrower. Management reports prepared daily by batch mode include an analytical summary of the number of books charged to faculty, students, staff, and area users, those on reserve, and those at the bindery. Ready-to-mail past due fine notices listing the computer-calculated fine amounts due are also generated by off-line batch processing.

Of the many systems investigated before the decision to automate was finally made, Midwestern's system would seem to involve both the patron and the library assistants less than any of the other systems analyzed. The many variables–status and eligibility of the borrower, the length of loan for each title, etc.–are handled entirely by the machine, systematically and consistently, and numerous interpretations of fines due that incorporate holiday periods or weekends, are handled by the machine with no student intervention, other than insertion of needed data into the terminal. With the addition of a cartridge input facility on the data input terminal, it is also possible to enter a borrower's identification number through a cartridge.

Though the installation at Midwestern University has not utilized the potential of multiple terminals throughout the campus in branch libraries or other facilities connected to the 1401, this is quite conceivable. Therefore, large libraries may well wish to consider the possibility of installing an in-house second generation computer which could handle circulation control for the main library and branch libraries in an on-line status, and which would at the same time be quite capable of handling most of other data processing requirements, except, of course, those reflecting proposals especially geared to third generation computers. Such systems could readily include other on-line operations (acquisitions, serials, etc., through a keyboard input station), in addition to the circulation control system.